

[54] CAM-OPERATED TIMER SWITCH
ASSEMBLY WITH IMPROVED FLEXIBLE,
PRINTED CIRCUIT TERMINAL
CONNECTORS

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339/17 C

[51] Int. Cl. H01h 43/10

[58] Field of Search 200/11 D, 11 DA, 38 R,
200/38 B, 38 BA, 38 C, 38 CA, 166 PC, 292;
317/101 F; 339/17 C, 17 L, 223 R, 256 R, 59
R, 59 M, 276 R

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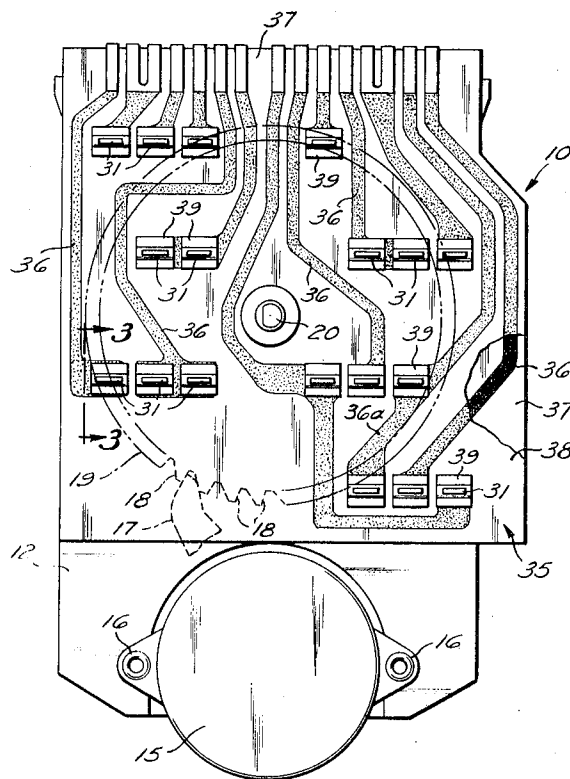
Primary Examiner—James R. Scott

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Pearne & Gordon

[57] ABSTRACT

A multiple circuit switch for use as an appliance timer is disclosed. The switch includes a housing and a disc rotatably mounted within the housing and having a cam face spaced from and parallel to a flat housing wall. A plurality of switches are provided between the cam face and the wall and are adapted to be opened and closed by concentrically disposed, radially spaced cam tracks on the cam face. The flat housing wall carries a plurality of flat conductors and each of a plurality of those conductors is electrically connected to at least one switch terminal, and each of a plurality of those conductors terminates at an edge of the housing in parallel alignment to other conductors for connection to other circuitry.

7 Claims, 7 Drawing Figures



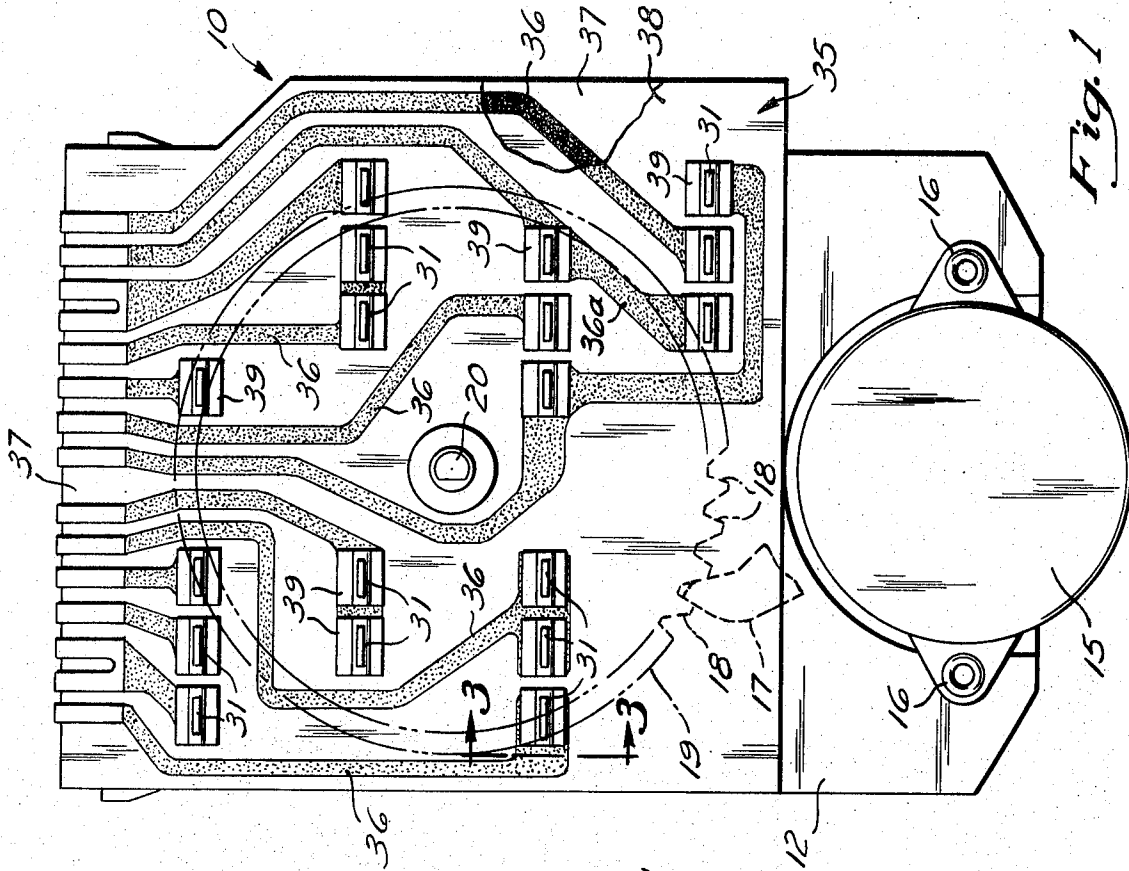


Fig. 1

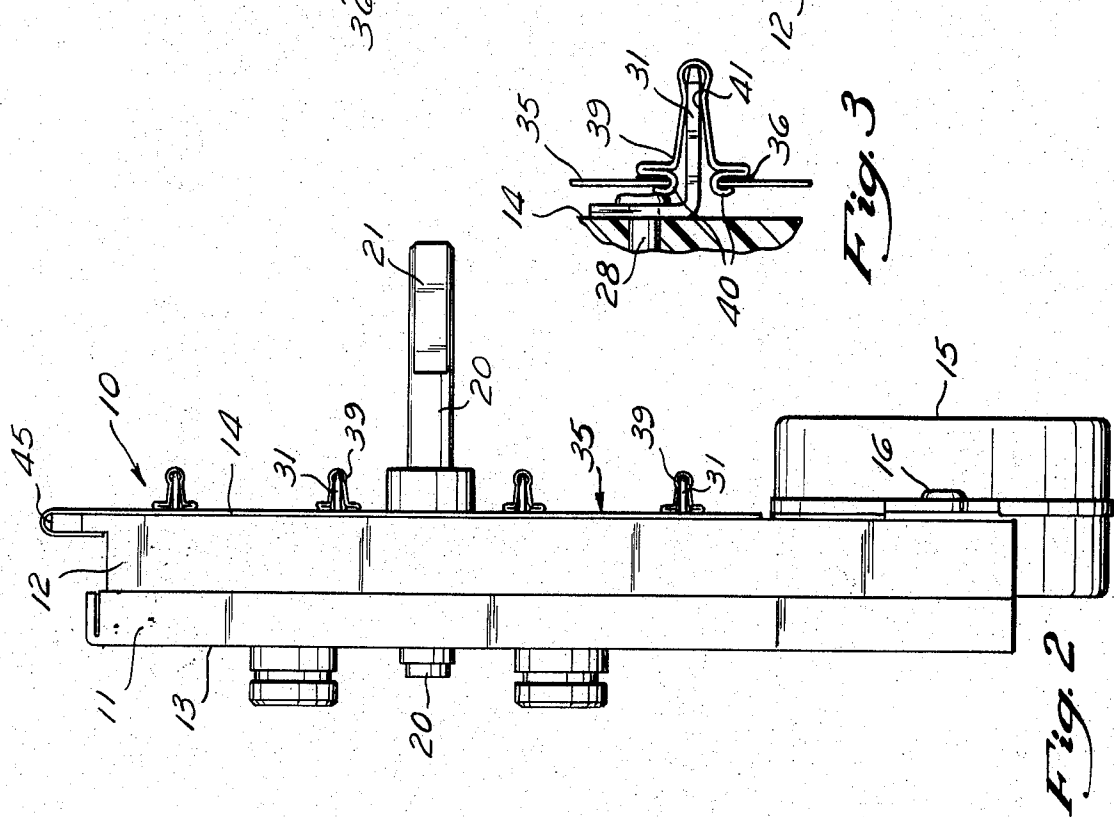


Fig. 2

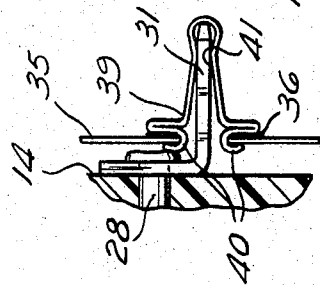
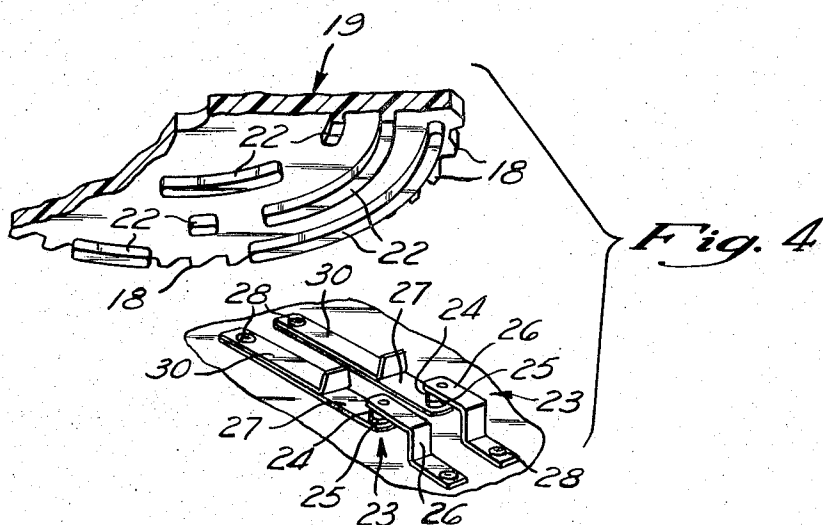
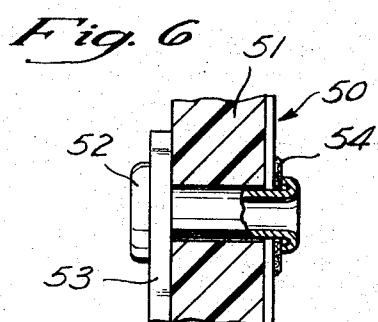
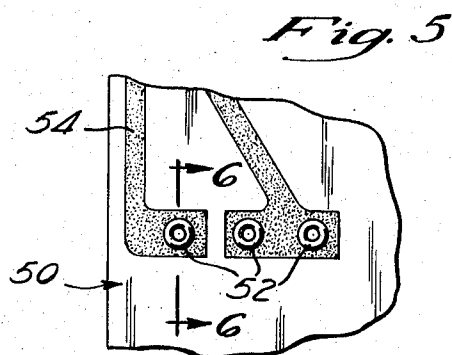
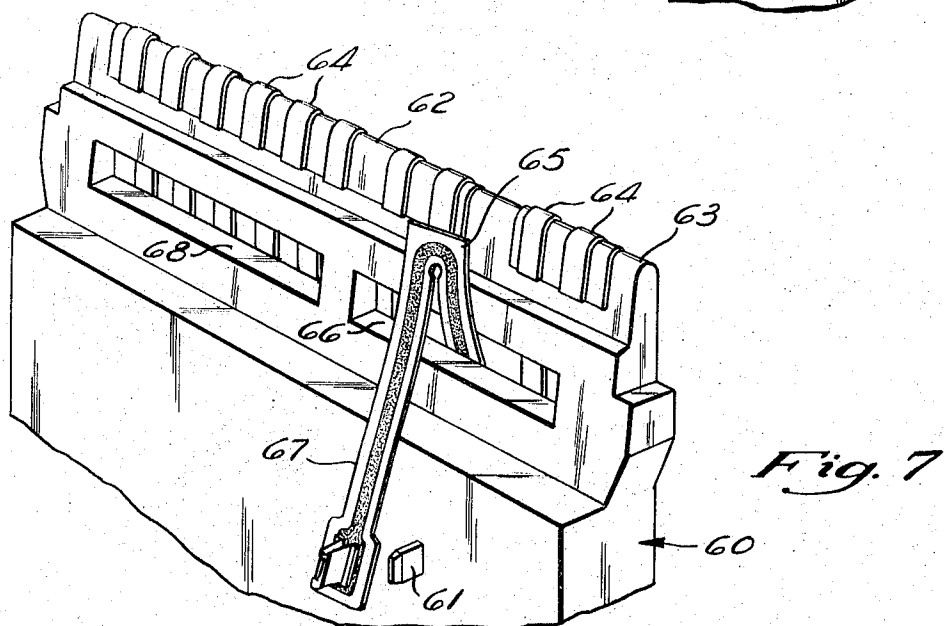


Fig. 3



CAM-OPERATED TIMER SWITCH ASSEMBLY WITH IMPROVED FLEXIBLE, PRINTED CIRCUIT TERMINAL CONNECTORS

BACKGROUND OF THE INVENTION

This invention relates to appliance timers, such as timers employed to control the various cycles of an automatic washing machine and, more particularly, to an improved wiring and busing arrangement for such timers.

Various types of appliances, e.g., washers, dryers, and the like, are provided with relatively elaborate systems which function to cause the appliance to operate automatically through a cycle of operation. Such control systems usually include a motor driven timer which automatically controls the operation of the various subsystems of the appliance to produce the desired cycle or cycles of operation. Such timers, because they control the operation of the various subsystems, require relatively large numbers of separate connections to the electrical system of the appliance. Moreover, in recent years, there has been an everincreasing number of features and functions added to modern washing machines and dryers. As a result, a number of switches and busing requirements have been added to timer arrangements, thereby increasing the number of terminal connections for the control wiring. Any repair or replacement of the timer usually requires the removal of a large number of individual wires when the timer is removed, and subsequent reconnection of the individual wires when the timer is replaced. Even with color coding or the like, the reconnection of wires is sometimes incorrectly accomplished, and difficulties have been encountered not only because the function of the sub-assemblies may be incorrect, but in some instances damage to some components has resulted. This is also true during the assembly of the appliance and, of course, connecting a number of wires to their terminals by hand adds to the cost of the appliance.

SUMMARY OF THE INVENTION

This invention overcomes these prior art problems by providing a timer having a housing wall which carries a plurality of flat conductors which are terminated in parallel alignment at an edge of the housing for quick-disconnect connection to other circuitry. Thus, during assembly of the appliance or during repair of the timer, the timer may be connected or disconnected with respect to the appliance circuitry by a simple and fool-proof, standard quick-disconnect connector, since all of the wiring from the switches to the disconnect terminal is accomplished by the timer manufacturer with no possible wiring errors by the appliance manufacturer or the service man.

The type of timer to which flat conductor circuitry may be applied is shown and described in U.S. Pat. No. 2,703,347, granted to Constantine. In this patent, there is disclosed a disc rotatably mounted within a housing and having a cam face spaced from and parallel to a flat housing wall. The cam face is provided with a plurality of concentrically disposed, radially spaced cam tracks in a common plane. A plurality of switches are provided between the cam face and the housing wall, which are adapted to be opened and closed by rotation of the disc about an axis normal to the cam face. The switches are provided with quick-disconnect terminals which extend through the housing wall for dis-

connect connection to other circuitry. Since the switches may be distributed about a relatively large area corresponding to the cam face area, it has been found that the switch terminals are ideally suited for connection to flat circuitry. The flat circuitry employed in accordance with this invention may comprise a laminate which includes flat strips of copper having a thickness of between about 0.006 inch to 0.010 inch and having a width which is dependent upon the current to be carried and is approximately 0.020 inch of width per ampere. The copper is deposited on paper and both sides of the paper carrying the flat circuit are coated with a suitable insulating plastic. A minimum dielectric spacing of 0.050 inch is required between circuits, and in view of this spacing requirement, it will be appreciated that the circuitry is ideally suited for terminal connections which are provided in an array on a relatively flat housing surface.

According to other aspects of this invention, the circuitry may be molded into the housing wall when that housing wall is manufactured.

The flat circuitry also permits busing in the flat circuitry to replace bus bars within the housing, which bus bars complicate the location and arrangement of switches in the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an appliance timer embodying the principles of this invention;

FIG. 2 is a side elevational view of the timer shown in FIG. 1;

FIG. 3 is a fragmentary, cross sectional view, the plane of the section being indicated by the line 3-3 in FIG. 1;

FIG. 4 is a fragmentary, exploded, perspective view illustrating the cooperation between the cam disc and switches;

FIG. 5 is a fragmentary plan view of flat circuitry according to another aspect of this invention;

FIG. 6 is a cross sectional view, the plane of the section being indicated by the line 6-6 in FIG. 5; and

FIG. 7 is a fragmentary, perspective view of a timer having flat circuitry arranged in accordance with a further aspect of this invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and particularly to FIGS. 1 through 4, there is illustrated an appliance timer 10 which is particularly suited for controlling the various cycles of an automatic washing machine. The timer 10 includes a two-part housing which comprises half-shell members 11 and 12. The members 11 and 12 are made from a suitable insulating material and form a hollow supporting structure having spaced walls 13 and 14, respectively.

A motor 15 is secured to the member 12 by rivets 16 and, through linkage means (not shown), drives an actuating pawl 17 in a step-by-step fashion. The actuating pawl sequentially engages ratchet teeth 18 which are provided on the periphery of a disc-shaped timing cam 19. A detent pawl (not shown) holds the timing cam in a stepped position and also prevents any movement thereof during the return motion of the actuating pawl 17 to its next tooth 18.

The timing cam 19 is mounted on a timing camshaft 20 which is journaled in bearings (not shown) provided in the housing. One end 21 of the shaft 20 projects from

the member 12 and a manual adjusting knob (not shown) is carried by that end.

The timing cam 19 is made from insulating material and is provided on at least one face with a plurality of concentrically disposed, radially spaced, arcuate cam tracks 22 (FIG. 4). As the cam 19 is rotated by the pawl 17, the cam tracks 22 operate switches 23 to provide the necessary "on" and "off" periods for the element or device controlled by that particular cam track.

Each of the switches 23 includes a pair of contacts 24 and 25, the contact 24 being carried on a relatively stiff support bracket 26, and the contact 25 being secured to a support means in the form of a flexible blade having a movable portion 27. The contact bracket 26 and the movable blade 27 are secured by rivets 28 and those rivets extend through the wall 14. Each of the switches 23 includes a cam follower 30 having an angularly directed ear which is engaged by a track 22 so that the switches 23 are opened and closed in response to rotation of the cam disc 19.

The rivets 28 project through the wall 14 and, as may be seen most clearly in FIG. 3, secure and electrically connect male disconnect connectors 31 to the switch elements.

The foregoing elements and combinations thereof are more fully set forth in U.S. Pat. No. 2,703,347 to Constantine, the disclosure of which is incorporated by reference herein. According to the teachings of that patent, the disconnect connectors are individually wired into circuits.

According to the teachings of this invention, the switches are associated with high-current, flat circuitry. Thus, according to the aspect of the invention illustrated in FIGS. 1 through 3, a flat circuitry laminate 35 is provided on the wall 14 and includes flat copper circuits or conductors 36 which are fused to a paper base 37. The paper base 37 is coated on both sides with a suitable insulating plastic 38. The laminate 35 is available from AMP, Inc. of Harrisburg, Pennsylvania under the trade name "High Current Flat circuitry." A plurality of the conductors 36 are electrically connected to female disconnect connectors 39. As may be seen most clearly in FIG. 3, the connectors 39 have legs or ears 40 which are crimped into the conductors 36. The connectors 39 also include a receptacle 41 into which the male disconnect connectors 31 are inserted. In this manner, a plurality of the conductors 36 are electrically connected to the switches 23. A plurality of those conductors 36 terminate at an edge 45 of the timer 10 for connection to other circuitry. As may be seen in FIGS. 1 and 2, the plastic 38 is omitted from a portion of the laminate to expose a group of parallel portions of the conductors, and that portion of the laminate is bent over the edge 45 to provide a connecting arrangement. The exposed portions of the conductors 36 may then be attached to a standard quick-disconnect receptacle carrying circuitry to other areas of the appliance.

Some of the conductors 36 extend from one connector 39 to another connector 39 to provide electrical connection or busing between switches. For example, the conductor 36a provides such an arrangement.

Referring now to FIGS. 5 and 6, flat circuitry for an appliance timer according to a further aspect of this invention is illustrated. According to this aspect of the invention, a flat circuitry laminate 50 may be permanently affixed to a wall 51 of an appliance timer by riv-

ets or other means which mechanically and electrically connect a switch element 53 to a flat conductor 54. It should also be appreciated that the flat circuitry may be molded into a housing wall when that wall is manufactured, or a flat circuitry laminate may be provided inside the wall rather than on its exterior.

Referring now to FIG. 7, an appliance timer 60 according to a further aspect of this invention is illustrated. The timer 60 is similar to the timer 10 illustrated in FIGS. 1 through 4, but is provided with disconnect connectors on both sides of the timer. Such an arrangement results when both sides of the disc cam are provided with cam tracks and, therefore, switches are mounted on both walls of the timer. Therefore, connectors such as the connector 61 are located on both sides of the timer. A portion 62 of a high current flat circuitry laminate is bent over an edge 63 of the timer 60 so that electrical connections can be made to exposed conductor ends 64 to provide electrical connections to the switch terminals on the side of the timer 60 which is not shown in FIG. 7. A portion 65 of the laminate is cut from the remainder of the laminate and is threaded through a window opening 66 in the timer 60 so that a branch portion 67 of the circuitry may be attached to the illustrated conductor 61. It should be appreciated that other portions of the circuit may be threaded through the window opening 66 or through an adjacent window opening 68 if other connections are necessary on the illustrated face of the timer 60.

The invention is not restricted to the slavish imitation of each and every detail set forth above. Obviously, devices may be provided which change, eliminate, or add certain specific details without departing from the scope of the invention.

What is claimed is:

1. Apparatus for opening and closing multiple electrical circuits in predetermined timed relation comprising a housing, a disc rotatably mounted within said housing and having a cam face spaced from and parallel to a flat housing wall, said cam face having a plurality of concentrically disposed, radially spaced cam tracks in a common plane, a plurality of switches between said cam face and said wall which are opened and closed in response to rotation of said disc about an axis normal to said cam face and in predetermined sequential or simultaneous manner by said cams, the opposite side of said flat housing wall carrying a plurality of flat conductors lying in a common plane, each of a plurality of said conductors being electrically connected at one end to at least one switch terminal and all of a plurality of said conductors terminating at their respective other ends in parallel alignment and at an edge of said housing for connection to other circuitry.

2. Apparatus for opening and closing multiple electrical circuits according to claim 1, wherein at least one of said flat conductors extends from one switch terminal to another switch terminal.

3. Apparatus for opening and closing multiple electrical circuits according to claim 1, wherein at least one of said conductors extends to another housing wall and is electrically connected to a terminal associated with said wall.

4. Apparatus for opening and closing multiple electrical circuits according to claim 3, wherein an opening is provided through said housing and wherein said at least one of said conductors extends through said open-

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ing for connection to the terminal associated with said another housing wall.

5. Apparatus for opening and closing multiple electrical circuits in predetermined timed relation, comprising a housing, a disc rotatably mounted within said housing and having a cam face spaced from and parallel to a flat housing wall, said cam face having a plurality of concentrically disposed, radially spaced cam tracks in a common plane, a plurality of switches between said cam face and said wall which are opened and closed in response to rotation of said disc about an axis normal to said cam face and in predetermined sequential or simultaneous manner by said cams, rivet means attaching said switches to the inner face of said wall and connecting an electrical connector to the other face of said wall, the outer face of said housing wall carrying a plurality of flat conductors lying in a common plane, each of said plurality of said conductors being electrically connected at one end to at least one of said connectors and all of a plurality of said conductors terminating at their respective other ends in parallel alignment at an edge of said housing for connection to other circuitry.

6. Apparatus for opening and closing multiple electrical circuits according to claim 5, wherein said flat conductors are encapsulated within a flexible flat laminate.

7. Apparatus for opening and closing multiple electrical circuits in predetermined timed relation, comprising a housing, a disc rotatably mounted within said housing and having a cam face spaced from and parallel to a flat housing wall, said cam face having a plurality of concentrically disposed, radially spaced cam tracks in a common plane, a plurality of switches between said cam face and said wall which are opened and closed in response to rotation of said disc about an axis normal to said cam face and in predetermined sequential or simultaneous manner by said cams, said flat housing wall carrying on its opposite surface a plurality of flat conductors lying in a common plane, each of a plurality of said conductors being electrically connected at one end to at least one switch by rivet means extending through said conductor and a switch terminal, and all of a plurality of said conductors terminating at their respective other ends in parallel alignment and at an edge of said housing for connection to other circuitry.

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